ISSN (print) 0093-4666 © 2015. Mycotaxon, Ltd. ISSN (online) 2154-8889

MYCOTAXON

http://dx.doi.org/10.5248/130.329

Volume 130, pp. 329–336 *April–June 2015*

New records of crustose lichens and a lichenicolous *Arthonia* from Vietnam

Santosh Joshi[1], Dalip Kumar Upreti[1], Soon-Ok Oh[2], Thi Thuy Nguyen[3], Anh Dzung Nguyen [3], & Jae-Seoun Hur[2]*

[1] *Lichenology Laboratory, CSIR-National Botanical Research Institute, Rana Pratap Marg, Lucknow (UP)-226001, India*

[2] *Korean Lichen Research Institute, Sunchon National University, Suncheon-540 950, Korea*

[3] *Institute of Biotechnology & Environment, Tay Nguyen University, 567 Le Duan, Buon Ma Thuot City, Lak Province, Vietnam*

*Correspondence to: *jshur1@sunchon.ac.kr*

Abstract — New records from Vietnam of the crustose lichen species *Arthonia excipienda*, *Chiodecton leptosporum*, *Graphidastra multiformis*, *Pertusaria pycnothelia*, *P. thwaitesii*, and *Phlyctis uncinata* are presented together with the second world report of the non-lichenized lichenicolous fungus, *Arthonia diorygmae*. All species were collected from the Bidoup Nui Ba National Park located in the central highlands in Vietnam. A taxonomic description of each species is accompanied by distributional and ecological data and illustrations.

Key words — corticolous, Đà Lạt city, evergreen forest, tropical

Introduction

A lichenological expedition was organized in 2014 by the National Research Foundation of Korea and the Korea National Research Resource Center Program. During fieldwork two of the authors collected a large number of crustose lichens growing predominantly on trees in evergreen forests of the Bidoup Nui Ba National Park in Vietnam. Among the more interesting collections, we report and describe six corticolous species new for the country. New Vietnamese records include *Arthonia excipienda,* first representatives of the genera *Chiodecton* (*C. leptosporum*), *Graphidastra* (*G. multiformis*), and *Phlyctis* (*P. uncinata*), and two new *Pertusaria* species (*P. pycnothelia, P. thwaitesii*) to be added the previously reported *P. asiana* Vain. and *P. pertusa* (L.) Tuck. (Aptroot & Sparrius 2006, Joshi et al. 2014).

The lichenicolous non-lichenized *Arthonia diorygmae* was found parasitizing a thallus of *Diorygma*, where it restricted the growth of the

host ascocarps. Although *Arthonia accolens* Stirt., *A. antillarum* (Fée) Nyl., *A. cinnabarina* (DC.) Wallr., *A. cyanea* Müll. Arg., and *A. microcephala* Vězda have been previously recorded from Vietnam as corticolous and foliicolous species (Aptroot & Sparrius 2006, Nguyen et al. 2011), no lichen-inhabiting fungus has ever been reported from Vietnam in *Arthonia* or any other genus.

Materials & methods

Morphological features of specimens collected from tropical rain forests of Đà Lạt city in Lam Dong province of Vietnam were examined under Magnus Zoom Stereo Trinocular (MSZ-TR) dissecting microscope and anatomical characters were observed under a compound microscope (Leica DM 500). Chemical spot tests and TLC (using solvent system A) were conducted according to Orange et al. (2010). The studied material is deposited in the herbarium of KoLRI (Korean Lichen Research Institute), South Korea.

Taxonomy

Arthonia diorygmae S. Joshi & Upreti, Lichenologist 45: 323, 2013. Pl. 1a

Thallus absent, non-lichenized, lichenicolous on *Diorygma;* ascomata dot-like, round, irregular to shortly lirellate, prominent; 0.2–0.3 × 0.1–0.2 mm; proper exciple completely carbonized to dark brown, 15–20 µm wide, in continuation with hypothecium, undulating, V-shaped; epihymenium brown, 15–25 µm high; hymenium hyaline, inspersed with oil droplets, gelatinous, ≤100 µm high, I+ wine red; paraphyses indistinct, 1–1.5 µm thick; asci broadly clavate, 8-spored, 40–50 × 13–15 µm, epiplasm I+ wine red; ascospores hyaline becoming dark brown and warty, 2-celled, ovoid to slipper-shaped, 10–16 × 4–5 µm, I–.

Chemistry: Ascomata (*Arthonia*): K–, PD–, C–. Thallus (*Diorygma* host species): K+ yellow, PD+ yellow-orange, C–; norstictic and stictic acid chemosyndrome detected in TLC of host species.

Distribution & ecology: This is the second report of *A. dorygma,* previously known only from the type locality in India (Joshi et al. 2013b). In Vietnam it was collected at ca. 1400 m from a thick- and smooth-barked tree, where it was growing luxuriantly and spread largely in association with *Cryptothecia*, *Diorygma*, and other graphidaceous taxa.

Specimens examined: **VIETNAM. Lam Dong province:** Bidoup Nui Ba National Park, Đà Lạt city, 12°10′55.4″N 108°40′50.1″E, alt. 1454 m, on tree bark, 7 January 2014, Hur & Oh VN140150, VN140098 (KoLRI).

Remarks: This species is distinctive in having non-lichenized lichenicolous life form. Though, our specimen differs from the *A. diorygmae* type material in also producing stictic acid by the host, all taxonomic characters were similar to those of the holotype described from the Western Ghats in India (Joshi et al. 2013b).

Arthonia excipienda (Nyl.) Nyl., Lich. Scand.: 261, 1861. Pl. 1B

Thallus corticolous, crustose, endoperidermal, smooth, continuous, shiny, pale green to yellowish, thin, 40–60 µm in cross section, corticate; cortex indistinct to 30 µm; photobiont cells chlorococcoid, aggregate to disperse, layer discontinuous, ≤25 µm; medulla indistinct; ascomata lirelliform, sessile; lirellae 0.5–1 × 0.1–0.2 mm; disc slightly open, black, epruinose; thalline margin absent to indistinct; proper exciple laterally carbonized, 25–30 µm wide, convergent, internally lined by 20–60 µm periphysoids; epihymenium brown, 10–15 µm high; hymenium hyaline, clear, gelatinous, 60–70 µm high, I+ blue; hypothecium hyaline to brownish 20–25 µm high; asci broadly clavate, 8-spored, 60–65 × 20–22 µm; ascospores hyaline to brown, 19–21 × 7–8 µm, I–.

Chemistry: K–, PD–, C–; no lichen compounds detected in TLC.

Distribution & ecology: The species was recorded from West European countries and South Korea (Joshi et al. 2013a); in Vietnam, it was found growing poorly at 1400–1500 m in association with other crustose corticolous lichens on smooth-barked trees.

Specimens examined: **VIETNAM. Lam Dong province:** Bidoup Nui Ba National Park, Đà Lạt city, 12°10′55.4″N 108°40′50.1″E, alt. 1454 m, on tree trunk, 7 January 2014, Hur & Oh VN140080 (KoLRI); 12°10′54.6″N 108°40′45.1″E, alt. 1426 m, on tree trunk, 8 January 2014, Hur & Oh VN140167 (KoLRI).

Remarks: *Arthonia excipienda*, an uncommon species in Asia, apparently resembles *A. punctiformis* Ach. and *A. radiata* (Pers.) Ach., which differ in having multiseptate ascospores. *Arthonia didyma* Körb. also produces 2-celled ascospores, but they are brown and warty on maturity.

Chiodecton leptosporum Müll. Arg., Flora 65: 332, 1882. Pl. 1C

Thallus corticolous, crustose, epiperidermal, tightly attached to the substrate, smooth to slightly verruculose, pale green, with a white pruina, 200–400 µm thick in cross section, ecorticate; photobiont cells *Trentepohlia*-like, layer ≤200 µm; medulla whitish with few calcium oxalate crystals, 200–250 µm, mostly endoperidermal; prothallus usually distinct, brownish; ascomata perithecioid, dot-like to round, solitary or rarely united, aggregated into distinctly elevated stroma-like structures usually with more than 10 ascocarps, 0.1–0.2 mm in diameter; stroma round to oval, 0.5–2 mm in diameter; proper exciple dark brown to completely carbonized, 25–45 µm; epihymenium brown, indistinct to 15 µm high; hymenium hyaline, clear, 135–140 µm high, I+ blue; hypothecium extending down to the substrate, hard and black, ≤200 µm high; paraphyses 1–1.5 µm thick; asci clavate, 8-spored, 80–100 × 9–12 µm, I–; ascospores obovate, hyaline, 3-septate, 30–40 × 3–4 µm, I–; locules cylindrical, 7–9 × 1–2 µm.

Chemistry: K–, PD–, C–; roccellic acid detected in TLC.

Distribution & ecology: *Chiodecton leptosporum* is widely distributed in Asia, Australia, and scattered localities in New Caledonia, Fiji, and Guam (Thor 1990); in Vietnam, it was luxuriantly growing at 1400–1500 m on hard-barked trees in an evergreen forest. The other lichens growing in association were unknown leprose taxa and *Cryptothecia*.

Specimens examined: **VIETNAM. Lam Dong province:** Bidoup Nui Ba National Park, Đà Lạt city, 12°10′55.4″N 108°40′50.1″E, alt. 1454 m, on tree bark, 7 January 2014, Hur & Oh VN140043, VN140065, VN140067, VN140078, VN140090 (KoLRI); 12°10′38.9″N 108°40′37.9″E, alt. 1426 m, on tree bark, 8 January 2014, Hur & Oh VN140149 (KoLRI).

Remarks: *Chiodecton leptosporum* can easily be confused with another most commonly distributed *C. congestulum* Nyl., which differs in a thallus containing a yellow pigmented medulla and a hymenium with a feeble iodine reaction. A comparatively rougher thallus and mostly united ascocarps further distinguish *C. congestulum* from *C. leptosporum*.

Graphidastra multiformis (Mont. & Bosch) G. Thor, Opera Bot. 103: 82, 1991.
Pl. 1d

Thallus corticolous, crustose, epiperidermal, tightly attached to the substrate, cretaceous, pale green to greenish grey, 200–300 µm thick in cross section, epinecral layer resembling cortex is present, 80–85 µm; photobiont cells *Trentepohlia*-like, layer ≤120 µm; medulla whitish, with few to numerous calcium oxalate crystals, 100–120 µm; prothallus whitish in inner part and brownish in outer part; ascomata usually lirelliform, but sometimes apothecioid, solitary; apothecioid and lirelliform structures distinctly elevated with a slightly to distinctly constricted base, 1–2 × 0.5–1 mm; disc black, 5–10 mm thick; thalline margin 130–330 µm thick; proper exciple thinly carbonized laterally, 15–20 µm, basally continuous with hypothecium; epihymenium brown, 25–35 µm; hymenium hyaline, clear, 60–85 µm, I+ reddish; hypothecium extending down to the substrate, hard, black, ± V-shaped, 0.3–0.5 mm; paraphyses 1–2 µm thick; asci clavate, 55–60 × 5–6 µm, I+ blue; ascospores hyaline, spermatoid, 3-septate, 35–40 × 2–3 µm (including tail of 20–22 µm), I–.

Chemistry: K–, PD–(?), C–; roccellic acid and traces of protocetraric acid detected in TLC.

Distribution & ecology: *Graphidastra multiformis* has previously been reported from India, Sri Lanka, The Philippines, Australia, West Samoa, and Tahiti (Thor 1990); in Vietnam it was collected at ca. 1400 m from thick- and hard-barked trees, where it was growing luxuriantly along with members of *Pannariaceae* and *Chiodecton leptosporum*.

Specimen examined: **VIETNAM. Lam Dong province:** Bidoup Nui Ba National Park, Đà Lạt city, 12°10′55.4″N 108°40′50.1″E, alt. 1454 m, on tree bark, 7 January 2014, Hur & Oh VN140075 (KoLRI).

Remarks: *Graphidastra multiformis* is close to *G. byssiseda* (Müll. Arg.) G. Thor in having spermatoid ascospores and a thallus containing roccellic acid, but *G. byssiseda* differs in producing bi-clavate larger ascospores and lacking protocetraric acid.

Pertusaria pycnothelia Nyl., Bull. Soc. Linn. Norm., ser. 2, 2: 70, 1868. Pl. 1e

Thallus corticolous, crustose, greenish grey to green or pale green, shiny, ± rimose, verrucose, ≤500 µm thick in cross section, corticate; cortex 20–25 µm; photobiont *Trebouxia*, layer 85–90 µm; medulla 180–320 µm; prothallus blackish; ascomata verruciform, numerous, scattered, sometimes confluent and forming an almost continuous crust, concolorous with the thallus, flattened, hemispherical, 0.5–0.8 mm in diam; ostiole conspicuous, brown, dark brown in apothecioid to blackish in verruciform, 0.3–0.5 mm in diam; thalline margin 300–370 µm wide; proper exciple hyaline to yellowish, 25–50 µm wide; epihymenium pale brown, 45–47 µm high; hymenium hyaline, clear, 300–400 µm high; subhymenium hyaline, 80–120 µm high; paraphyses 1–2 µm thick; asci broadly clavate, 2-spored; ascospores hyaline, ellipsoid to subfusiform, double walled, wall smooth, 50–75 × 17–25 µm, I+ blue.

Chemistry: K–, KC–, C–, PD–; 4,5-dichlorolichexanthone and 2'-O-methylperlatolic acid detected in TLC.

Distribution & ecology: *Pertusaria pycnothelia* was previously reported from Australia, New Caledonia, and Papua New Guinea (Archer 1997); in Vietnam, it was collected at 1400–1500 m, where it was growing in small patches over tree bark in an evergreen forest.

Specimen examined: **VIETNAM. Lam Dong province:** Bidoup Nui Ba National Park, Đà Lạt city, 12°10′55.4″N 108°40′50.1″E, alt. 1454 m, on tree bark, 7 January 2014, Hur & Oh VN140096 (KoLRI).

Remarks: The chemically similar *Pertusaria trachyspora* A.W. Archer is distinguished from *P. pycnothelia* by ascospores with a rough inner wall.

Pertusaria thwaitesii Müll. Arg., Flora 67: 470, 1884. Pl. 1f

Thallus corticolous, crustose, epiperidermal, wrinkled, cracked, uneven, shiny, off-white to pale grey, 100–150 µm thick in cross section, corticate; cortex 10–15 µm; photobiont *Trebouxia*, layer 50–80 µm; medulla white, 70–90 µm; prothallus jet black; ascomata verruciform, conspicuous, concolorous with the thallus, numerous, very flattened hemispherical or irregular in outline, 1–2 mm wide; ostioles numerous, conspicuous, pale yellow becoming black, punctiform, becoming somewhat sunken, 0.05–0.07 mm in diam., 4–7 per verruca; proper exciple hyaline to yellowish, indistinct to 30 µm wide; epihymenium indistinct; hymenium hyaline, clear, ≤430 µm high; subhymenium indistinct; asci broadly

clavate, 2-spored, 290–300 × 45–50 µm; ascospores elongate ellipsoid, double walled, inner wall ornamented and outer wall smooth, 140–165 × 35–45 µm.

Chemistry: K–, PD+ orange-red, C–; protocetraric acid detected in TLC.

Distribution & ecology: Known from Australia, Papua New Guinea, Sri Lanka (Archer 1997); in Vietnam, *Pertusaria thwaitesii* was growing in association with *Graphis* at 1700–1800 m in trees in an evergreen forest.

Specimen examined: **VIETNAM. Lam Dong province:** Mt Langbian, Đà Lạt city, 12°02′18.6″N 108°25′35.1″E, alt. 1779 m, on tree bark, 9 January 2014, Hur & Oh VN140281 (KoLRI).

Remarks: *Pertusaria hartmannii* Müll. Arg., which superficially resembles *P. thwaitesii*, differs in producing smoother ascospores and a thallus containing norstictic acid (Archer 1997).

Phlyctis uncinata Stirt., J. Linn. Soc., Bot. 14: 464, 1875. Pl. 1G

Thallus corticolous, crustose, rough, epiperidermal, subleprose, ± rimose due to substrate, greenish grey, whitish green to greyish green, 100–130 µm thick in cross section, ecorticate; photobiont cells green protococcoid, layer 50–70 µm; medulla white, 40–50 µm; prothallus white; ascomata round to irregular, solitary to aggregate, immersed, 0.4–0.5 mm; disc blackish, finely pruinose, 0.2–0.3 mm in diameter; thalline margin recurved, 165–180 µm wide; proper exciple hyaline to brownish, apically dark, 35–55 µm wide; epihymenium granular, brownish 12–15 µm high; hymenium hyaline, clear, 65–80 µm high, I+ wine red; subhymenium ≤40 µm high; asci clavate, 8-spored, 110–165 × 15–25 µm, I+ wine red; ascospores hyaline, fusiform, crescent shape, transversely septate, 50–54 × 5–7 µm, 8-locular, I+ wine red.

Chemistry: K+ yellow turning red, PD+ yellow-orange, C–; norstictic acid detected in TLC.

Distribution & ecology: Known from New Zealand and Thailand (Galloway 1985, 2007); in Vietnam, the species was collected at 1700–1800 m, where it was spread in short patches on rough-barked trees.

Specimen examined: **VIETNAM. Lam Dong province:** Mt Langbian, Đà Lạt city, 12°02′18.6″N 108°25′35.1″E, alt. 1779 m, on tree bark, 9 January 2014, Hur & Oh VN140109 (KoLRI).

Remarks: *Phlyctis uncinata* is closely related to *P. karnatakana* S. Joshi & Upreti, which differs in having small (20–30 µm long) ascospores (Joshi et al. 2010). The thallus of *Phlyctis himalayensis* (Nyl.) D.D. Awasthi is morphologically similar but reacts K+ red (Awasthi 1991). *Phlyctis,* which has poorly delimited species, needs further revision to clarify the status of *P. uncinata* (Joshi & Upreti 2012; Joshi et al. 2010, 2012).

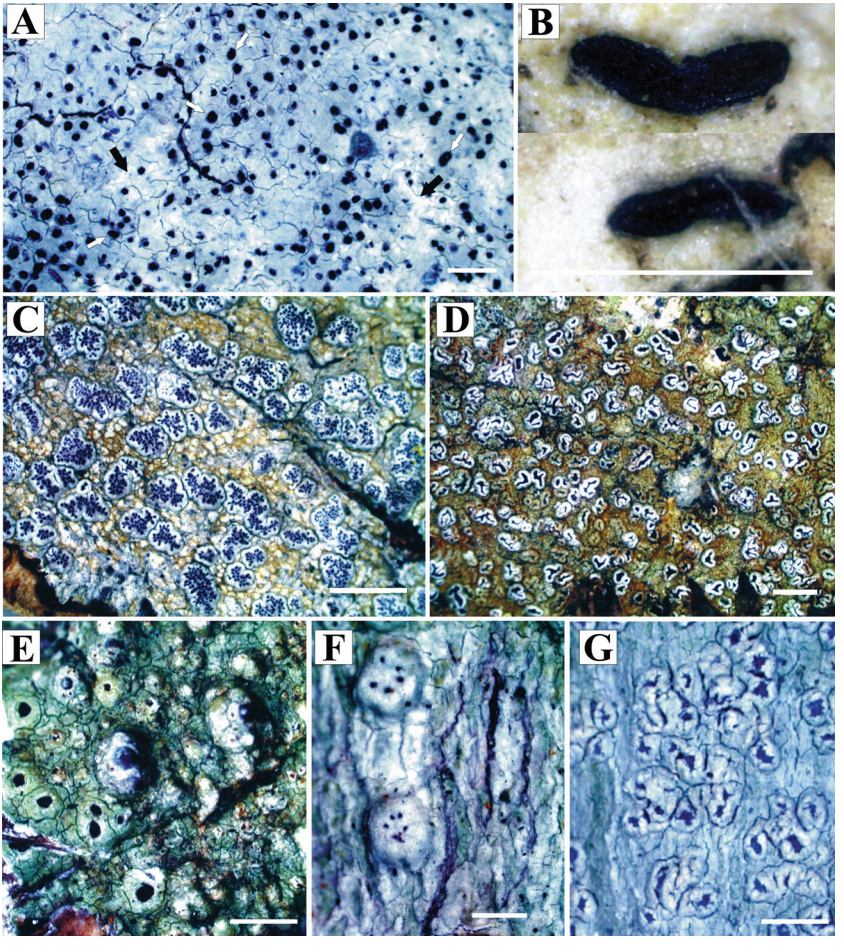

Plate. 1. New records of lichens from Vietnam. A. *Arthonia diorygmae* (white arrow indicating ascomata of *Arthonia* and black arrow indicating suppressed growth of ascomata in host); B. *Arthonia excipienda* (ascomata); C. *Chiodecton leptosporum*; D. *Graphidastra multiformis*; E. *Pertusaria pycnothelia*; F. *Pertusaria thwaitesii*; G. *Phlyctis uncinata*. Scale bars: A, F, G = 0.5 mm; B, E = 1 mm; C, D = 2 mm.

Acknowledgments

This work was supported by a grant from the National Research Foundation of Korea (#2011–0031494) and the Korea National Research Resource Center Program. Authors are grateful to Drs. S.Y. Kondratyuk and L. Lőkös for their valuable comments on the manuscript. DKU and SJ thank Director, CSIR-National Botanical Research Institute, Lucknow, India, for providing infrastructure to facilitate the identification of Korean lichen material.

Literature cited

Aptroot A, Sparrius LB. 2006. Additions to the lichen flora of Vietnam, with an annotated checklist and bibliography. Bryologist 109(3): 358–371. http://dx.doi.org/10.1639/0007–2745(2006)109[358:ATTLFO]2.0.CO;2

Archer AW. 1997. The lichen genus *Pertusaria* in Australia. Bibliotheca Lichenologica 69. 249 p.

Awasthi DD. 1991. A key to the microlichens of India, Nepal and Sri Lanka. Bibliotheca Lichenologica 40. 337 p.

Galloway DJ. 1985. *Phlyctella* Krempelh. 385–389, in: Flora of New Zealand Lichens. Government Printer, Wellington, New Zealand.

Galloway DJ. 2007. *Phlyctis* (Wallr.) Flot. 1184–1191, in: Flora of New Zealand Lichens, 2nd ed., Vol. 2. Manaaki Whenua Press, Lincoln, New Zealand.

Joshi S, Upreti DK. 2012. Lichen genus *Phlyctis* (*Phlyctidaceae*) in India. Geophytology 44(3): 363–369.

Joshi S, Upreti DK, Mishra GK, Divakar PK. 2010. Two new species of lichen genus *Phlyctis* in India. Bryologist 113(4): 724–727. http://dx.doi.org/10.1639/0007–2745–113.4.724

Joshi S, Upreti DK, Nayaka S. 2012. Two new species in the lichen genus *Phlyctis* (*Phlyctidaceae*) from India. Lichenologist 44(3): 363–369. http://dx.doi.org/10.1017/S0024282911000879

Joshi S, Kondratyuk SY, Crisan F, Jayalal U, Oh SO, Hur JS. 2013a. New additions to lichen mycota of the Republic of Korea. Mycobiology 41(4): 177–182. http://dx.doi.org/10.5941/MYCO.2013.41.4.177

Joshi S, Upreti DK, Nayaka S. 2013b. A new lichenicolous *Arthonia* species (*Arthoniaceae*) on *Diorygma* from India. Lichenologist 45(3): 323–327. http://dx.doi.org/10.1017/S0024282913000042

Joshi S, Jayalal U, Oh SO, Nguyen TT, Dzung NA, Hur JS. 2014. A new species of *Graphis* and new lichen records from Vietnam, including a second worldwide report of *Sarcographina cyclospora*. Mycobiology 42(1): 17–21. http://dx.doi.org/10.5941/MYCO.2014.42.1.17

Nguyen TT, Joshi Y, Lücking R, Nguyen AD, Wang XY, Koh YJ, Hur JS. 2011. Seven new records of foliicolous lichens from Vietnam. Mycotaxon 117: 93–99. http://dx.doi.org/10.5248/117.93

Orange A, James PW, White FJ. 2010. Microchemical methods for the identification of lichens. British Lichen Society, London.

Thor G. 1990. The lichen genus *Chiodecton* and five allied genera. Opera Botanica 103. 92 p.